NASA/TM-2000-209891, Vol. 71



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Jaime Nickeson, Editors

Volume 71 BOREAS RSS-17 Stem, Soil, and Air Temperature Data

R. Zimmerman, K.C. McDonald, and J.B. Way

National Aeronautics and Space Administration

Goddard Space Flight Center Greenbelt, Maryland 20771

The NASA STI Program Office ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and mission, often concerned with subjects having substantial public interest.
- TECHNICAL TRANSLATION.
 English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at http://www.sti.nasa.gov/STI-homepage.html
- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA Access Help Desk at (301) 621-0134
- Telephone the NASA Access Help Desk at (301) 621-0390
- Write to:
 NASA Access Help Desk
 NASA Center for AeroSpace Information
 7121 Standard Drive

Hanover, MD 21076-1320

NASA/TM-2000-209891, Vol. 71



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Jaime Nickeson, Editors

Volume 71 BOREAS RSS-17 Stem, Soil, and Air Temperature Data

Reiner Zimmerman, Bayreuth Institute for Terrestrial Ecosystem Research (BITOEK), University of Bayreuth, Bayreuth, Germany Kyle C. McDonald, Jet Propulsion Laboratory, Pasadena, California JoBea Way, Jet Propulsion Laboratory, Pasadena, California

National Aeronautics and Space Administration

Goddard Space Flight Center Greenbelt, Maryland 20771

	Available from:	
NIACA Contourfour Armong units of		Notional Tasks: -1 Informed C
NASA Center for AeroSpace Information		National Technical Information Service
7121 Standard Drive		5285 Port Royal Road
Hanover, MD 21076-1320		Springfield, VA 22161
Drica Codo: A17		Dring Code, A10
Price Code: A17		Price Code: A10

BOREAS RSS-17 Stem, Soil, and Air Temperature Data

Kyle McDonald, Reiner Zimmermann, JoBea Way

Summary

The BOREAS RSS-17 team collected several data sets in support of its research in monitoring and analyzing environmental and phenological states using radar data. This data set consists of tree bole and soil temperature measurements from various BOREAS flux tower sites. Temperatures were measured with thermistors implanted in the hydroconductive tissue of the trunks of several trees at each site and at various depths in the soil. Data were stored on a data logger at intervals of either 1 or 2 hours. The majority of the data were acquired between early 1994 and early 1995. The primary product of this data set is the diurnal stem temperature measurements acquired for selected trees at five BOREAS tower sites. The data are provided in tabular ASCII format.

Table of Contents

- 1) Data Set Overview
- 2) Investigator(s)
- 3) Theory of Measurements
- 4) Equipment
- 5) Data Acquisition Methods
- 6) Observations
- 7) Data Description
- 8) Data Organization
- 9) Data Manipulations
- 10) Errors
- 11) Notes
- 12) Application of the Data Set
- 13) Future Modifications and Plans
- 14) Software
- 15) Data Access
- 16) Output Products and Availability
- 17) References
- 18) Glossary of Terms
- 19) List of Acronyms
- 20) Document Information

1. Data Set Overview

1.1 Data Set Identification

BOREAS RSS-17 Stem, Soil, and Air Temperature Data

1.2 Data Set Introduction

This documentation file describes tree bole and soil temperature data acquired during the BOReal Ecosystem-Atmosphere Study (BOREAS) field experiment at five of the BOREAS tower sites. The tree bole data were collected in separate but representative trees at each of the tower sites. Data were collected from the Southern Study Area (SSA) at the Old Black Spruce (OBS), Old Jack Pine (OJP), Old Aspen (OA), and Young Jack Pine (YJP) sites. Data were also collected at the Northern Study Area (NSA) OBS site. The majority of the data were acquired between early 1994 and early 1995.

All of the temperature data were collected with 3-mm x 3-mm x 1-mm thermistors. Data were postprocessed to derive temperature values (in Celsius) from the raw data taken (in kOhms) by

resistance measurements from nonlinear response-type thermistors. Thermistors were implanted in the hydroconductive tissues of selected tree trunks and at various depths in the soil. Measurements were recorded automatically on a data logger at 1- or 2-hour intervals.

1.3 Objective/Purpose

These measurements were taken to assist with the interpretation of radar backscatter measurements obtained with the Earth Resource Satellite-1 (ERS-1) Synthetic Aperture Radar (SAR). Data were used to assess the freeze/thaw state of the soil and vegetation to aid interpretation of the radar images.

1.4 Summary of Parameters and Variables

The primary measured parameter is diurnal vegetation temperature. Some soil and air temperatures were collected at a subset of sites.

1.5 Discussion

Temperature measurements were used to quantify freeze/thaw transitions in the soil and vegetation. Landscape freeze/thaw transitions are readily observable with imaging radar. Thus, radar may be applied to assess growing season length in boreal landscapes.

1.6 Related Data Sets

BOREAS RSS-17 Dielectric Constant Profile Measurements BOREAS RSS-17 Xylem Flux Density Measurements at the SSA-OBS Site BOREAS RSS-17 1994 ERS-1 Level-3 Backscatter Change Images

2. Investigator(s)

2.1 Investigator(s) Name and Title

Principal Investigator Dr. JoBea Way Scientist

Co-Investigators

Dr. Kyle McDonald Scientist

Dr. Reiner Zimmermann Scientist

2.2 Title of Investigation

Monitoring Environmental and Phenologic State and Duration of State with SAR as Input to Improved CO₂ Flux Models

2.3 Contact Information

Contact 1:

Dr. JoBea Way
Jet Propulsion Laboratory
Mail Stop 300-233
California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109
USA
(818) 354-8225
(818) 354-9476 (fax)
way@lor.jpl.nasa.

Contact 2:

Dr. Kyle McDonald
Jet Propulsion Laboratory
Mail Stop 300-233
California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109
USA
(818) 354-3263
(818) 354-9476 (fax)
kyle.mcdonald@jpl.nasa.gov

Contact 3:

Dr. Reiner Zimmermann
Bayreuth Institute for Terrestrial Ecosystem Research (BITOEK)
Plant Ecology II
University of Bayreuth
D-95445 Bayreuth
GERMANY
+49-921-555624
+49-921-555799 (fax)
reiner.zimmermann@bitoek.uni-bayreuth.de

Contact 4:

Jaime Nickeson Raytheon ITSS NASA GSFC Code 923 Greenbelt, MD 20771 (301) 286-3373 (301) 286-0239 (fax) Jaime.Nickeson@gsfc.nasa.gov

3. Theory of Measurements

Thermistor sensors are variable resistors that change their electrical resistance to a direct current (DC) in a predictable manner depending on the ambient temperature. This study used Siemens-841-3K type thermistors that have a nonlinear decrease of resistance with increasing temperature and a negligible hysteresis. The small resistor size ensures a fast response to temperature changes in the measured environment (tree boles/soil/air).

The temperature response of each sensor is better than the desired temperature resolution of $0.25\,^{\circ}$ C. Temperatures were calculated from the measured resistance and a conversion algorithm. The algorithm was derived using the manufacturer's resistance-temperature conversion table. Sensor response was checked under controlled temperature conditions against 1) table values for electrical resistance and 2) calculated temperature values when using the conversion algorithm. Deviation of the calculated temperature from the manufacturer's temperature table was less than 0.2 degrees between -40 and $+40\,^{\circ}$ C.

Approximately 8 to 12 trees were monitored at each installation to verify similar or uniform behavior of the freeze/thaw state of the tree trunks.

4. Equipment

4.1 Sensor/Instrument Description

Thermistors were connected to stranded and insulated cables with a screen cover (computer signal cable type).

4.1.1 Collection Environment

Soil temperatures were collected with capsuled soil thermistors inserted into holes drilled in the soil and then backfilled. Tree bole temperatures were collected using insulated thermistors that were inserted into 4- to 5-mm holes drilled into the tree boles. The holes were closed with silicone after insertion of the thermistor.

4.1.2 Source/Platform

The tree temperature sensors were mounted directly in the trees being monitored. Soil sensors were inserted to depths between 5 cm and 50 cm, as noted in the data files.

4.1.3 Source/Platform Mission Objectives

The objective of these measurements was to support interpretation of radar remote sensing observations, especially during the spring thaw and autumn freeze-up periods.

4.1.4 Key Variables

The key variables being measured were stem, soil, and air temperatures. The measurements were converted to °C.

4.1.5 Principles of Operation

Thermistor sensors are variable resistors that change their electrical resistance to a DC in a predictable manner depending on the ambient temperature. By monitoring the DC resistance of a thermistor, one may infer the ambient temperature in the medium surrounding the device.

4.1.6 Sensor/Instrument Measurement Geometry

Thermistors were implanted in the tree trunks at appropriately 1.8 meters above the soil. Sensors were inserted to depths between 5 and 20 mm, as noted in the data files. Soil sensors were inserted to depths between 5 and 50 cm, as noted in the data files. Measurement accuracy of the thermistors was determined to be \pm 0.2 °C, as based on laboratory testing.

4.1.7 Manufacturer of Sensor/Instrument

Sensor units were constructed in the field at BOREAS. Thermistors were manufactured by Siemens, Germany, and are available from numerous U.S. electronic supply houses. The thermistor type was Siemens Heissleiter M841 / 3 K / a1.

4.2 Calibration

4.2.1 Calibration Specifications

Temperature was calculated from the measured resistance and a conversion algorithm. The algorithm was based on the manufacturer's resistance-temperature conversion table. Sensor response was checked under controlled temperature conditions against 1) table values for electrical resistance and 2) calculated temperature values when using the conversion algorithm. Deviation of the calculated from the manufacturer's temperature table was less than 0.2 degrees between -40 and +40 °C.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

Further calibration of these instruments was not performed.

4.2.3 Other Calibration Information

None given.

5. Data Acquisition Methods

Soil temperatures were collected with capsuled soil thermistors inserted into holes drilled in the soil and then backfilled. Tree bole temperatures were collected using insulated thermistors that were inserted into 4- to 5-mm holes drilled into the tree boles. The holes were closed with silicone after insertion of the thermistor.

Measurements were processed and stored with a Delta-T data logger (DL-2), which is manufactured in England. The time interval for the data storage varied during the observation period. Data were measured every minute and averaged by the logger for the indicated time interval. Data storage occurred at the end of the time interval averaged.

A constant current source of 20 microAmperes provided by the logger was used to measure the DC resistance of each thermistor.

Data were stored in the data logger and downloaded by laptop during site visits.

6. Observations

6.1 Data Notes

None given.

6.2 Field Notes

None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The tree stem temperature data submitted to the BOREAS Information system (BORIS) were collected at five general sites:

- NSA-OBS
- SSA-OBS
- SSA-OJP
- SSA-OA
- SSA-YJP

The stem temperature data were collected at every site visited, in a minimum of 4 and a maximum of 11 different trees. The number of trees from which stem temperature data were collected varied by site. The minimum numbers of trees measured was 4 and the maximum number of trees measured was 11. The air temperature data were measured at one location at each of two sites (SSA-OJP and SSA-OA). Air temperature measurements were not made at the three remaining sites. Soil temperature data were measured at three depths at the NSA-OBS site and at four depths at the SSA-YJP site. Soil temperature measurements were not made at the remaining three sites. The North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) coordinates for the sites are:

Site	UTM Zone	UTM Northing	UTM Easting	stem	soil	air
NSA-OBS	14	6192853.4	532444.5	x	x	
SSA-YJP	13	5969762.5	523320.2	x	x	
SSA-OJP	13	5974257.5	520227.7	x		X
SSA-OBS	13	5982100.5	492276.5	x		
SSA-OA	13	5942899.9	420790.5	x		x

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

The air, soil, and stem temperature measurements taken by the Remote Sensing Science (RSS)-17 team are directly representative only of the medium into which the thermistors were inserted at the sites listed.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

The data were continuously collected over the various sites during the period from 25-Oct-1993 to 27-Apr-1995. A more detailed breakdown by site is given in section 7.2.2.

7.2.2 Temporal Coverage Map

Site	Dates of data collection
NSA-OBS	13-Apr-1994 to 30-Oct-1994
SSA-OBS	25-Oct-1993 to 27-Apr-1995
SSA-OA	16-Feb-1994 to 25-Apr-1995
SSA-OJP	19-Feb-1994 to 26-Apr-1995
SSA-YJP	15-Jul-1994 to 26-Apr-1995

7.2.3 Temporal Resolution

The time interval between actual temperature measurements was 1 minute. These observations were then averaged over time periods ranging from 10 minutes to 1 hour. The averaged values are the temperatures given in the data files.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

For NSA-OBS site:

Column Name

SITE NAME

SUB_SITE

DATE_OBS

TIME OBS

SOIL_TEMP_50MM

SOIL TEMP 250MM

SOIL_TEMP_450MM

BS1_STEM_TEMP_H1800_D5_N

BS1_STEM_TEMP_H1800_D20_N

BS2_STEM_TEMP_H1800_D5_N

BS2_STEM_TEMP_H1800_D20_N

BS3_STEM_TEMP_H1800_D5_N

BS3 STEM TEMP H1800 D20 N

CRTFCN_CODE

REVISION DATE

For SSA-OBS site:

Column Name

SITE_NAME

SUB_SITE

DATE_OBS

TIME OBS

JP1_STEM_TEMP_H1400_D5_E

JP1_STEM_TEMP_H1400_D20_E

T1_STEM_TEMP_H1000_D5_NE

T1_STEM_TEMP_H1000_D20_NE

BS1 STEM TEMP H1000 D5 NE

BS1_STEM_TEMP_H1000_D20_NE

BS1_STEM_TEMP_H800_D5_NE

BS1_STEM_TEMP_H800_D20_NE

CRTFCN_CODE

REVISION DATE

For SSA-OA site:

Column Name

SITE_NAME

SUB SITE

DATE_OBS

TIME OBS

AIR_TEMP_6600MM

ASP1_STEM_TEMP_H2000_D5

ASP1 STEM TEMP H2000 D20

ASP1_STEM_TEMP_H2000_D20_N

ASP1_STEM_TEMP_H2000_D20_W

ASP2_STEM_TEMP_H2000_D5

CRTFCN CODE

REVISION_DATE

For SSA-OJP site:

Column Name

SITE NAME

SUB_SITE

DATE_OBS

TIME OBS

AIR_TEMP_2000MM

JP1 STEM TEMP H1700 D20 SW

JP1_STEM_TEMP_H1700_D20_N

JP1_STEM_TEMP_H1700_D40_NW

JP1_STEM_TEMP_H1700_D20_SE

JP1_STEM_TEMP_H1700_D40_SE

JP1 STEM TEMP H1700 D50 N

JP1_STEM_TEMP_H1700_D50_S

JP1_STEM_TEMP_H1700_D20_NW

JP1_STEM_TEMP_H1700_D20_NE

 ${\tt JP2_STEM_TEMP_H1700_D20_SE}$

JP2_STEM_TEMP_H1700_D20_NW

CRTFCN_CODE

REVISION_DATE

For SSA-YJP site:

Column Name

SITE NAME

SUB_SITE

DATE_OBS

TIME_OBS

SOIL_TEMP_50MM

SOIL_TEMP_150MM

SOIL_TEMP_250MM

SOIL_TEMP_400MM

JP1_STEM_TEMP_H600_D5_NE

JP1_STEM_TEMP_H600_D20_NE

JP2 STEM TEMP H600 D5 NE

JP2_STEM_TEMP_H600_D20_NE

CRTFCN_CODE

REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

For NSA-OBS site:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by

instrument e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument. DATE OBS The date on which the data were collected. TIME OBS The Greenwich Mean Time (GMT) at the end of the period when the data were collected. SOIL TEMP 50MM Soil temperature measured at a depth of 50 mm from the top of the moss layer (NSA-OBS) or soil surface (SSA-YJP). Sensor at NSA-OBS was in decomposing moss. SOIL_TEMP_250MM Soil temperature measured at a depth of 250 mm below the top of the moss layer (NSA-OBS) or the soil surface (SSA-YJP). Sensor was in mineral soil. SOIL_TEMP_450MM Soil temperature measured at a depth of 450 mm below the top the moss layer. The probe was in mineral soil. BS1 STEM TEMP H1800 D5 N Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure. BS1_STEM_TEMP_H1800_D20_N Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure. BS2_STEM_TEMP_H1800_D5_N Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a second Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure. BS2_STEM_TEMP_H1800_D20_N Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure. BS3 STEM TEMP H1800 D5 N Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a third Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure. BS3_STEM_TEMP_H1800_D20_N Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure. CRTFCN CODE The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable). The most recent date when the information in the REVISION_DATE referenced data base table record was revised.

BOREAS, in the format GGGGG-IIIII, where GGGGG is

the group associated with the sub-site

For SSA-OBS site:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with
SUB_SITE	site type. The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS TIME_OBS	The date on which the data were collected. The Greenwich Mean Time (GMT) at the end of the period when the data were collected.
JP1_STEM_TEMP_H1400_D5_E	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Jack Pine tree at a height of 1400 mm above the soil surface with an east-facing exposure (dbh=220mm).
JP1_STEM_TEMP_H1400_D20_E	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1400 mm above the soil surface with an east-facing exposure (dbh=220mm).
T1_STEM_TEMP_H1000_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Tamarack tree at a height of 1000 mm above the soil surface with a northeast-facing exposure (dbh=150mm).
T1_STEM_TEMP_H1000_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Tamarack tree at a height of 1000 mm above the soil surface with a northeast-facing exposure (dbh=150mm).
BS1_STEM_TEMP_H1000_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Black Spruce tree at 1000 mm above the soil surface with a northeast-facing exposure.
BS1_STEM_TEMP_H1000_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Black Spruce tree at a height of 1000 mm above the soil surface with a northeast-facing exposure.
BS1_STEM_TEMP_H800_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Black Spruce tree at a height of 800 mm above the soil surface with a northeast-facing exposure.
BS1_STEM_TEMP_H800_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a

Black Spruce tree at a height of 800 mm above the soil surface with a northeast-facing exposure. The BOREAS certification level of the data. CRTFCN CODE

Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI

but questionable).

REVISION DATE The most recent date when the information in the referenced data base table record was revised.

For SSA-OA site:

Column Name Description ______

SITE_NAME The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG,

> TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with

site type.

SUB SITE The identifier assigned to the sub-site by

BOREAS, in the format GGGGG-IIIII, where GGGGG is

the group associated with the sub-site

instrument e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to

an instrument.

DATE OBS The date on which the data were collected. TIME OBS

The Greenwich Mean Time (GMT) at the end of the

period when the data were collected.

AIR TEMP 6600MM Air temperature measurements collected at a

height of 6.6 meters above the ground.

Stem temperature measurements from a probe ASP1 STEM TEMP H2000 D5

> inserted to a depth of 5 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil

surface. The exposure is unknown.

ASP1_STEM_TEMP_H2000_D20 Stem temperature measurements from a probe

> inserted to a depth of 20 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil

surface. The exposure is unknown.

ASP1_STEM_TEMP_H2000_D20_N Stem temperature measurements from a probe

> inserted to a depth of 20 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil

surface with a north-facing exposure.

ASP1_STEM_TEMP_H2000_D20_W Stem temperature measurements from a probe

> inserted to a depth of 20 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil

surface with a west-facing exposure.

ASP2 STEM TEMP H2000 D5 Stem temperature measurements from a probe

> inserted to a depth of 5 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil

surface. The exposure is unknown.

CRTFCN CODE The BOREAS certification level of the data.

> Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI

but questionable).

The most recent date when the information in the referenced data base table record was revised.

For SSA-OJP site:

101 5511	Column Name	Description
SITE_NAM	Е	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE		The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS		The date on which the data were collected.
TIME_OBS		The Greenwich Mean Time (GMT) at the end of the
		period when the data were collected.
AIR_TEMP	_2000MM	Air temperature measured at a height of 2 meters
TD1 CTEM	_TEMP_H1700_D20_SW	above the ground. Stem temperature measurements from a probe
OPI_SIEM	_1EMF_H1700_D20_SW	inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a southwest-facing exposure.
JP1_STEM	_TEMP_H1700_D20_N	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a north-facing exposure.
JP1_STEM	_TEMP_H1700_D40_NW	Stem temperature measurements from a probe inserted to a depth of 40 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a northwest-facing exposure.
JP1_STEM	_TEMP_H1700_D20_SE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a southeast-facing exposure.
JP1_STEM	_TEMP_H1700_D40_SE	Stem temperature measurements from a probe inserted to a depth of 40 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a southeast-facing exposure.
JP1_STEM	_TEMP_H1700_D50_N	Stem temperature measurements from a probe inserted to a depth of 50 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a north-facing exposure.
JP1_STEM	_TEMP_H1700_D50_S	Stem temperature measurements from a probe inserted to a depth of 50 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a south-facing exposure.
JP1_STEM	_TEMP_H1700_D20_NW	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a

Jack Pine tree at a height of 1700 mm above the soil surface with a northwest-facing exposure. JP1 STEM TEMP H1700 D20 NE Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a northeast-facing exposure. JP2_STEM_TEMP_H1700_D20_SE Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Jack Pine tree at a height of 1700 mm above the soil surface with a southeast-facing exposure. JP2_STEM_TEMP_H1700_D20_NW Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Jack Pine tree at a height of 1700 mm above the soil surface with a northwest-facing exposure. CRTFCN_CODE The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable). The most recent date when the information in the REVISION DATE referenced data base table record was revised.

For SSA-YJP site:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) at the end of the period when the data were collected.
SOIL_TEMP_50MM	Soil temperature measured at a depth of 50 mm from the top of the moss layer (NSA-OBS) or soil surface (SSA-YJP). Sensor at NSA-OBS was in decomposing moss.
SOIL_TEMP_150MM	Soil temperature measured at a depth of 150 mm below the soil surface.
SOIL_TEMP_250MM	Soil temperature measured at a depth of 250 mm below the top of the moss layer (NSA-OBS) or the soil surface (SSA-YJP). Sensor was in mineral soil.
SOIL_TEMP_400MM	Soil temperature measured at a depth of 400 mm below the soil surface.

Stem temperature measurements from a probe JP1_STEM_TEMP_H600_D5_NE inserted to a depth of 5 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=35mm). JP1_STEM_TEMP_H600_D10_NE Stem temperature measurements from a probe inserted to a depth of 10 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=35mm). JP2_STEM_TEMP_H600_D5_NE Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=38mm). JP2 STEM TEMP H600 D10 NE Stem temperature measurements from a probe inserted to a depth of 10 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=38mm). CRTFCN CODE The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable). REVISION DATE The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

For NSA-OBS site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
SOIL_TEMP_50MM	[degrees Celsius]
SOIL_TEMP_250MM	[degrees Celsius]
SOIL_TEMP_450MM	[degrees Celsius]
BS1_STEM_TEMP_H1800_D5_N	[degrees Celsius]
BS1_STEM_TEMP_H1800_D20_N	[degrees Celsius]
BS2_STEM_TEMP_H1800_D5_N	[degrees Celsius]
BS2_STEM_TEMP_H1800_D20_N	[degrees Celsius]
BS3_STEM_TEMP_H1800_D5_N	[degrees Celsius]
BS3_STEM_TEMP_H1800_D20_N	[degrees Celsius]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

For SSA-OBS site:

Column Name	Units
SITE NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
JP1_STEM_TEMP_H1400_D5_E	[degrees Celsius]
JP1_STEM_TEMP_H1400_D20_E	[degrees Celsius]
T1_STEM_TEMP_H1000_D5_NE	[degrees Celsius]
T1_STEM_TEMP_H1000_D20_NE	[degrees Celsius]
BS1_STEM_TEMP_H1000_D5_NE	[degrees Celsius]
BS1_STEM_TEMP_H1000_D20_NE	[degrees Celsius]
BS1_STEM_TEMP_H800_D5_NE	[degrees Celsius]
BS1_STEM_TEMP_H800_D20_NE	[degrees Celsius]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]
For SSA-OA site:	
Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
AIR_TEMP_6600MM	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D5	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D20	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D20_N	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D20_W	[unitless]

[degrees Celsius]

For SSA-OJP site:

CRTFCN_CODE

REVISION DATE

ASP2 STEM TEMP H2000 D5

Column Name Units

[none]

[DD-MON-YY]

SITE NAME [none] SUB_SITE [none] DATE OBS [DD-MON-YY] TIME_OBS [HHMM GMT] AIR TEMP 2000MM [degrees Celsius] JP1_STEM_TEMP_H1700_D20_SW [degrees Celsius] JP1_STEM_TEMP_H1700_D20_N [degrees Celsius] JP1_STEM_TEMP_H1700_D40_NW [degrees Celsius] JP1_STEM_TEMP_H1700_D20_SE [degrees Celsius] JP1 STEM TEMP H1700 D40 SE [degrees Celsius] JP1_STEM_TEMP_H1700_D50_N [degrees Celsius] JP1 STEM TEMP H1700 D50 S [degrees Celsius] JP1_STEM_TEMP_H1700_D20_NW [degrees Celsius] JP1_STEM_TEMP_H1700_D20_NE [degrees Celsius] JP2_STEM_TEMP_H1700_D20_SE [degrees Celsius] JP2_STEM_TEMP_H1700_D20_NW [degrees Celsius] CRTFCN_CODE [none]

For SSA-YJP site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
SOIL_TEMP_50MM	[degrees Celsius]
SOIL_TEMP_150MM	[degrees Celsius]
SOIL_TEMP_250MM	[degrees Celsius]
SOIL_TEMP_400MM	[degrees Celsius]
JP1_STEM_TEMP_H600_D5_NE	[degrees Celsius]
JP1_STEM_TEMP_H600_D10_NE	[degrees Celsius]
JP2_STEM_TEMP_H600_D5_NE	[degrees Celsius]
JP2_STEM_TEMP_H600_D10_NE	[degrees Celsius]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

For NSA-OBS site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
SOIL_TEMP_50MM	[Capsuled soil thermistor]
SOIL_TEMP_250MM	[Capsuled soil thermistor]
SOIL_TEMP_450MM	[Capsuled soil thermistor]
BS1_STEM_TEMP_H1800_D5_N	[Insulated thermistor]
BS1_STEM_TEMP_H1800_D20_N	[Insulated thermistor]
BS2_STEM_TEMP_H1800_D5_N	[Insulated thermistor]
BS2_STEM_TEMP_H1800_D20_N	[Insulated thermistor]
BS3_STEM_TEMP_H1800_D5_N	[Insulated thermistor]
BS3_STEM_TEMP_H1800_D20_N	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

For SSA-OBS site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
JP1_STEM_TEMP_H1400_D5_E	[Insulated thermistor]
JP1_STEM_TEMP_H1400_D20_E	[Insulated thermistor]
T1_STEM_TEMP_H1000_D5_NE	[Insulated thermistor]
T1_STEM_TEMP_H1000_D20_NE	[Insulated thermistor]
BS1_STEM_TEMP_H1000_D5_NE	[Insulated thermistor]

BS1_STEM_TEMP_H1000_D20_NE [Insulated thermistor]
BS1_STEM_TEMP_H800_D5_NE [Insulated thermistor]
BS1_STEM_TEMP_H800_D20_NE [Insulated thermistor]
CRTFCN_CODE [Assigned by BORIS Staff]
REVISION_DATE [Assigned by BORIS Staff]

For SSA-OA site:

Column Name Data Source

SITE_NAME [Assigned by BORIS Staff]
SUB_SITE [Assigned by BORIS Staff]
DATE_OBS [Data logger]
TIME_OBS [Data logger]
AIR TEMP 6600MM [Ambient temperature sensor]

ASP1_STEM_TEMP_H2000_D5 [Insulated thermistor]

ASP1_STEM_TEMP_H2000_D3 [Insulated thermistor]
ASP1_STEM_TEMP_H2000_D20_N [Insulated thermistor]
ASP1_STEM_TEMP_H2000_D20_W [Insulated thermistor]
ASP1_STEM_TEMP_H2000_D5 [Insulated thermistor]
CRTFCN_CODE [Assigned by BORIS Staff]
REVISION_DATE [Assigned by BORIS Staff]

For SSA-OJP site:

Column Name Data Source

SITE_NAME [Assigned by BORIS Staff]
SUB SITE [Assigned by BORIS Staff]

DATE_OBS [Data logger]
TIME_OBS [Data logger]

AIR_TEMP_2000MM [Ambient temperature sensor]

JP1_STEM_TEMP_H1700_D20_SW [Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_N [Insulated thermistor]
JP1_STEM_TEMP_H1700_D40_NW [Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_SE [Insulated thermistor]
JP1_STEM_TEMP_H1700_D50_N [Insulated thermistor]
JP1_STEM_TEMP_H1700_D50_S [Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_NW [Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_NE [Insulated thermistor]
JP2_STEM_TEMP_H1700_D20_SE [Insulated thermistor]
JP2_STEM_TEMP_H1700_D20_NW [Insulated thermistor]
JP2_STEM_TEMP_H1700_D20_NW [Insulated thermistor]
CRTFCN_CODE [Assigned by BORIS Staff]
REVISION_DATE [Assigned by BORIS Staff]

For SSA-YJP site:

Column Name Data Source

SITE_NAME [Assigned by BORIS Staff]
SUB_SITE [Assigned by BORIS Staff]

DATE_OBS [Data logger]
TIME_OBS [Data logger]

SOIL_TEMP_50MM [Capsuled soil thermistor]
SOIL_TEMP_150MM [Capsuled soil thermistor]
SOIL_TEMP_250MM [Capsuled soil thermistor]

SOIL_TEMP_400MM	[Capsuled soil thermistor]
JP1_STEM_TEMP_H600_D5_NE	[Insulated thermistor]
JP1_STEM_TEMP_H600_D10_NE	[Insulated thermistor]
JP2_STEM_TEMP_H600_D5_NE	[Insulated thermistor]
JP2_STEM_TEMP_H600_D10_NE	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

7.3.5 Data RangeThe following table gives information about the parameter values found inbthe data files on the CD-ROM.

For NSA-OBS site:						
	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data				Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	NSA-OBS-FLXTR	NSA-OBS-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	13-APR-94	30-OCT-94	None	None	None	None
TIME_OBS	0	2330	None	None	None	None
SOIL_TEMP_50MM	-11.19	37.03	None	None	None	None
SOIL_TEMP_250MM			None	None	None	None
SOIL_TEMP_450MM			-999	None	None	None
BS1_STEM_TEMP_H1800_	-13.5	23.39	None	None	None	None
D5_N						
BS1_STEM_TEMP_H1800_	-12.27	23.96	None	None	None	None
D20_N						
BS2_STEM_TEMP_H1800_	-13.36	23.44	None	None	None	None
D5_N						
BS2_STEM_TEMP_H1800_	-13.33	24.19	None	None	None	None
D20_N						
BS3_STEM_TEMP_H1800_	-12.48	23.5	None	None	None	None
D5_N						
BS3_STEM_TEMP_H1800_	-13.04	24.3	None	None	None	None
D20_N	_					
CRTFCN_CODE		CPI	None	None	None	None
REVISION_DATE				None	None	None

For SSA-OBS site:

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-OBS-FLXTR	SSA-OBS-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	25-OCT-93	27-APR-95	None	None	None	None
TIME_OBS	0	2350	None	None	None	None
JP1_STEM_TEMP_H1400_	-37	30.3	None	None	None	None
D5_E						
JP1_STEM_TEMP_H1400_	-36.8	28.67	None	None	None	None
D20_E						
T1_STEM_TEMP_H1000_	-39.37	24.45	None	None	None	None

D5_NE T1_STEM_TEMP_H1000_	_40 73	21.44	None	None	None	None
D20 NE	10.75	21.11	NOTIC	NOTIC	NOTIC	NOTIC
BS1_STEM_TEMP_H1000_	-39.43	26.47	None	None	None	None
D5_NE						
BS1_STEM_TEMP_H1000_	-39.36	26.31	None	None	None	None
D20_NE BS1_STEM_TEMP_H800_	_20 72	31.6	-999	None	None	None
D5_NE	-39.72	31.0	- 333	None	NOTIE	NOHE
BS1_STEM_TEMP_H800_	-40.05	32.2	-999	None	None	None
D20_NE						
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	23-JUL-98	23-JUL-98	None	None	None	None
For SSA-OA site:						
	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	
Column Name	Value	Value	Value	Value	Limit	
SITE NAME	SSA-90A-FLXTR		None	None	None	None
SUB SITE	RSS17-SST01		None	None	None	None
DATE_OBS	16-FEB-94	25-APR-95	None	None	None	None
TIME_OBS	0	2330	None	None	None	None
AIR_TEMP_6600MM	-19.9	28.41	-999	None	None	None
ASP1_STEM_TEMP_H2000		27.1	-999	-888	None	None
D5						
ASP1_STEM_TEMP_H2000 D20	31.58	26.9	-999	None	None	None
ASP1_STEM_TEMP_H2000	32.28	26.27	-999	None	None	None
D20_N						
ASP1_STEM_TEMP_H2000	32.56	26.15	-999	None	None	None
D20_W ASP2 STEM TEMP H2000	_33 05	29.49	-999	None	None	None
D5	_ 33.03	27.47		None	NOTIE	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	10-JUL-98	10-JUL-98	None	None	None	None
For SSA-OJP site:						
roi bba-our site.	Minimum	Maximum	Missnq	Unrel	Below	Data
	Data	Data	Data			
Column Name	Value	Value	Value		Limit	
SITE_NAME		SSA-OJP-FLXTR		None	None	None
SUB_SITE	RSS17-SST01			None	None	None
DATE_OBS	19-FEB-94			None	None	None
TIME_OBS	0	2350	None	None	None	None
AIR_TEMP_2000MM				None	None	None
JP1_STEM_TEMP_H1700_	-30.13	29.49	-999	None	None	None
D20_SW JP1_STEM_TEMP_H1700_	_36_01	27.78	-999	None	None	None
D20_N	-30.01	41.10	- > > >	None	None	None
JP1_STEM_TEMP_H1700_	-35.88	16.67	-999	None	None	None
						-

-36.12	16.95	-999	None	None	None
-36.14	16.79	-999	None	None	None
-36.34	16.41	-999	None	None	None
-36.64	16.85	-999	None	None	None
-36.47	16.77	-999	None	None	None
-36.5	18.2	-999	None	None	None
-36.31	19.28	-999	None	None	None
-32.97	16.73	-999	None	None	None
CPI 21-AUG-97	CPI 21-AUG-97	None None	None None	None None	None None
	-36.14 -36.34 -36.64 -36.47 -36.5 -36.31 -32.97 CPI	-36.14 16.79 -36.34 16.41 -36.64 16.85 -36.47 16.77 -36.5 18.2 -36.31 19.28 -32.97 16.73 CPI CPI	-36.14 16.79 -999 -36.34 16.41 -999 -36.64 16.85 -999 -36.47 16.77 -999 -36.5 18.2 -999 -36.31 19.28 -999 -32.97 16.73 -999 CPI CPI None	-36.14 16.79 -999 None -36.34 16.41 -999 None -36.64 16.85 -999 None -36.47 16.77 -999 None -36.5 18.2 -999 None -36.31 19.28 -999 None -32.97 16.73 -999 None CPI CPI None None	-36.14 16.79 -999 None None -36.34 16.41 -999 None None -36.64 16.85 -999 None None -36.47 16.77 -999 None None -36.5 18.2 -999 None None -36.31 19.28 -999 None None -32.97 16.73 -999 None None CPI CPI None None

For SSA-YJP site:

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-YJP-FLXTR		None	None	None	None
SUB_SITE DATE_OBS	RSS17-SST01	RSS17-SST01	None	None	None	None
	15-JUL-94	26-APR-95	None	None	None	None
TIME_OBS SOIL_TEMP_50MM	0	2350	None	None	None	None
	-9.34	21.83	None	None	None	None
SOIL_TEMP_150MM	-8.75	18.22	None	None	None	None
SOIL_TEMP_250MM	-11.22	17.88	None	None	None	None
SOIL_TEMP_400MM	-5.52	16.57	None	None	None	None
JP1_STEM_TEMP_H600_	-45.71	35.96	-999	None	None	None
D5_NE JP1_STEM_TEMP_H600_	-46.19	37.9	-999	None	None	None
D10_NE JP2_STEM_TEMP_H600_ D5 NE	-46.03	34.84	-999	None	None	None
JP2_STEM_TEMP_H600_ D10 NE	-45.46	35.23	-999	None	None	None
CRTFCN_CODE REVISION_DATE	CPI	CPI	None	None	None	None
	20-AUG-97	20-AUG-97	None	None	None	None

For ALL sites:

Minimum Data Value -- The minimum value found in the column.

Maximum Data Value -- The maximum value found in the column.

Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.

Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be

unreliable by the analysis personnel.

Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the

parameter value, but the analysis personnel determined that the parameter value was below the detection

limit of the instrumentation.

Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.

 ${\rm N/A}$ -- Indicates that the value is not applicable to the respective column.

None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record

The following is a sample of the first few records from the data table on the CD-ROM (records may wrap here if longer than 80 characters):

For NSA-OBS site:

SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,SOIL_TEMP_50MM,SOIL_TEMP_250MM,
SOIL_TEMP_450MM,BS1_STEM_TEMP_H1800_D5_N,BS1_STEM_TEMP_H1800_D20_N,
BS2_STEM_TEMP_H1800_D5_N,BS2_STEM_TEMP_H1800_D20_N,BS3_STEM_TEMP_H1800_D5_N,
BS3_STEM_TEMP_H1800_D20_N,CRTFCN_CODE,REVISION_DATE
'NSA-OBS-FLXTR','RSS17-SST01',01-AUG-94,0,20.79,5.88,.34,13.85,13.65,13.94,14.23,
13.58,14.25,'CPI',21-AUG-97
'NSA-OBS-FLXTR','RSS17-SST01',01-AUG-94,100,19.23,5.92,.34,13.48,13.65,13.65,
13.99,13.48,14.06,'CPI',21-AUG-97
'NSA-OBS-FLXTR','RSS17-SST01',01-AUG-94,200,16.71,5.91,.33,12.75,13.43,13.0,
13.43,12.98,13.61,'CPI',21-AUG-97

For SSA-OBS site:

SITE_NAME, SUB_SITE, DATE_OBS, TIME_OBS, JP1_STEM_TEMP_H1400_D5_E,

JP1_STEM_TEMP_H1400_D20_E, T1_STEM_TEMP_H1000_D5_NE, T1_STEM_TEMP_H1000_D20_NE,

BS1_STEM_TEMP_H1000_D5_NE, BS1_STEM_TEMP_H1000_D20_NE, BS1_STEM_TEMP_H800_D5_NE,

BS1_STEM_TEMP_H800_D20_ NE, CRTFCN_CODE, REVISION_DATE

'SSA-OBS-FLXTR', 'RSS17-SST01', 01-JUL-94, 30, 12.54, 12.42, 11.47, 2.1, 11.1, 11.43, 8.81,

13.48, 'CPI', 23-JUL-98

'SSA-OBS-FLXTR', 'RSS17-SST01', 01-JUL-94, 130, 12.5, 12.43, 11.53, 2.04, 11.17, 11.56,

8.63, 12.98, 'CPI', 23-JUL-98

'SSA-OBS-FLXTR', 'RSS17-SST01', 01-JUL-94, 230, 12.2, 12.34, 11.38, 2.1, 10.71, 11.53,

7.81, 12.04, 'CPI', 23-JUL-98

For SSA-OA site:

SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,AIR_TEMP_6600MM,ASP1_STEM_TEMP_H2000_D5, ASP1_STEM_TEMP_H2000_D20,ASP1_STEM_TEMP_H2000_D20_W,ASP1_STEM_TEMP_H2000_D5,CRTFCN_CODE,REVISION_DATE
'SSA-90A-FLXTR','RSS17-SST01',01-AUG-94,0,25.55,17.15,20.79,22.46,23.11,23.28,
'CPI',10-JUL-98
'SSA-90A-FLXTR','RSS17-SST01',01-AUG-94,30,25.16,16.99,20.82,22.4,23.05,23.3,
'CPI',10-JUL-98

```
'SSA-90A-FLXTR', 'RSS17-SST01',01-AUG-94,100,24.87,16.83,20.87,22.35,23.03,23.3, 'CPI',10-JUL-98
```

For SSA-OJP site:

```
SITE_NAME, SUB_SITE, DATE_OBS, TIME_OBS, AIR_TEMP_2000MM, JP1_STEM_TEMP_H1700_D20_SW, JP1_STEM_TEMP_H1700_D20_N, JP1_STEM_TEMP_H1700_D40_NW, JP1_STEM_TEMP_H1700_D20_SE, JP1_STEM_TEMP_H1700_D50_N, JP1_STEM_TEMP_H1700_D50_S, JP1_STEM_TEMP_H1700_D20_NW, JP1_STEM_TEMP_H1700_D20_NE, JP2_STEM_TEMP_H1700_D20_NW, CRTFCN_CODE, REVISION_DATE

'SSA-OJP-FLXTR', 'RSS17-SST01', 01-APR-94, 0, 8.64, 10.62, 7.18, 6.42, 10.84, 10.9, 4.1, 10.95, 6.8, 4.99, 10.74, 11.66, 'CPI', 21-AUG-97

'SSA-OJP-FLXTR', 'RSS17-SST01', 01-APR-94, 30, 7.5, 10.22, 7.18, 6.67, 10.32, 10.45, 4.77, 10.32, 6.79, 5.3, 10.33, 11.12, 'CPI', 21-AUG-97

'SSA-OJP-FLXTR', 'RSS17-SST01', 01-APR-94, 100, 6.64, 9.82, 7.09, 6.75, 9.8, 10.0, 5.0, 10.05, 6.75, 5.43, 9.89, 10.59, 'CPI', 21-AUG-97
```

For SSA-YJP site:

```
SITE_NAME, SUB_SITE, DATE_OBS, TIME_OBS, SOIL_TEMP_50MM, SOIL_TEMP_150MM, SOIL_TEMP_250MM, SOIL_TEMP_400MM, JP1_STEM_TEMP_H600_D5_NE, JP1_STEM_TEMP_H600_D10_NE, JP2_STEM_TEMP_H600_D5_NE, JP2_STEM_TEMP_H600_D10_NE, CRTFCN_CODE, REVISION_DATE

'SSA-YJP-FLXTR', 'RSS17-SST01', 01-AUG-94, 0, 20.84, 17.46, 17.11, 15.95, 28.71, 29.15, 28.24, 28.71, 'CPI', 20-AUG-97

'SSA-YJP-FLXTR', 'RSS17-SST01', 01-AUG-94, 30, 20.87, 17.54, 17.17, 15.91, 28.97, 29.38, 28.35, 28.86, 'CPI', 20-AUG-97

'SSA-YJP-FLXTR', 'RSS17-SST01', 01-AUG-94, 100, 20.77, 17.63, 17.25, 15.95, 28.82, 29.19, 27.82, 28.82, 'CPI', 20-AUG-97
```

8. Data Organization

8.1 Data Granularity

The unit of data tracked by BORIS is all the data collected at a site on a given day or for a given time period.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

None given.

9.1.1 Derivation Techniques and Algorithms

None given.

9.2 Data Processing Sequence

9.2.1 Processing Steps

Thermistor resistance was measured in kOhms and converted to °C using the manufacturer's data conversion table.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None given.

9.3.2 Calculated Variables

Thermistor resistance was measured in kOhms and converted to °C using the manufacturer's data conversion table.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Thermistors may read higher temperatures than their environment when exposed to direct radiation or if output leads get shorted by moisture in cables with faulty insulation. The latter is a problem after rain if the shorting resistance is very high, and its effect is hard to separate/detect from true readings of sensor resistance.

10.2 Quality Assessment

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

Measurement accuracy of the thermistors was determined to be +/- 0.2 °C, as based on laboratory testing.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

None given.

10.2.5 Data Verification by Data Center

BOREAS staff performed initial quality checks while loading the data into BORIS. This was, by no means, an exhaustive effort. Individual users are cautioned that unreliable data may still be present.

11. Notes

11.1 Limitations of the Data

None given.

11.2 Known Problems with the Data

None given.

11.3 Usage Guidance

None given.

11.4 Other Relevant Information

- NSA-OBS: One soil temperature sensor was also inserted to a depth of 700 mm below the surface but it was shorted during the season in 1994 by cable damage and thus not used in this data file.
- SSA-OA: One stem temperature probe was also inserted at 10 mm into JP1, but the sensor readings were found to be erratic beginning in September 1994. Data collected after this date were removed.
- SSA-OBS: Four soil temperature sensors were also inserted to a depth of 50, 250, 450, and 700 mm below the surface, but they were shorted by sensor and cable damage during 1994 and thus the data were not included in this file.

12. Application of the Data Set

Radar may be applied to assess growing season length in boreal landscapes.

13. Future Modifications and Plans

No future modifications are planned.

14. Software

14.1 Software Description

Data conversion was performed in Sigmaplot 4.0 for DOS (Jandel Scientific, acquired by SPSS, Inc., http://www.spss.com/ [Internet Link]).

14.2 Software Access

The software mentioned above may be acquired from SPSS, Inc., or a software reseller.

15. Data Access

The RSS-17 stem, soil, and air temperature data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services Oak Ridge National Laboratory P.O. Box 2008 MS-6407 Oak Ridge, TN 37831-6407 Phone: (423) 241-3952

Fax: (423) 574-4665

E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/ [Internet Link].

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation None given.

17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation None.

18. Glossary of Terms

None.

19. List of Acronyms

ASCII - American Standard Code for Information Interchange

BOREAS - BOReal Ecosystem-Atmosphere Study

BORIS - BOREAS Information System

CD-ROM - Compact Disk-Read-Only Memory

DAAC - Distributed Active Archive Center

DC - Direct Current

EOS - Earth Observing System

EOSDIS - EOS Data and Information System
ERS-1 - Earth Resources Satellite-1
GIS - Geographic Information System

GSFC - Goddard Space Flight Center HTML - HyperText Markup Language

NASA - National Aeronautics and Space Administration

NSA - Northern Study Area

OA - Old Aspen

OBS - Old Black Spruce OJP - Old Jack Pine

ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
RSS - Remote Sensing Science
SAR - Synthetic Aperture Radar

SSA - Southern Study Area
URL - Uniform Resource Locator

UTM - Universal Transverse Mercator

YJP - Young Jack Pine

20. Document Information

20.1 Document Revision Date(s)

Written: 15-Jul-1997

Last Updated: 26-Jul-1999

20.2 Document Review Date(s)

BORIS Review: 10-Jun-1998

Science Review:

20.3 Document ID

None.

20.4 Citation

When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

Please acknowledge the efforts of the following investigators when using this data set: R. Zimmermann, K.C. McDonald, J.B. Way.

If using data from the BOREAS CD-ROM series, also reference the data as:

Way, J.B., K. McDonald, and R. Zimmermann, "Monitoring Environmental and Phenologic State and Duration of State with SAR as Input to Improved CO₂ Flux Models." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE August 2000	Technical M	
4. TITLE AND SUBTITLE Technical Report Series on the Bo BOREAS RSS-17 Stem, Soil,	5. FUNDING NUMBERS 923		
6. AUTHOR(S) Reiner Zimmerman, Kyle C. I Forrest G. Hall and Jaime Nic		ay	RTOP: 923-462-33-01
7. PERFORMING ORGANIZATION NAME Goddard Space Flight Center Greenbelt, Maryland 20771	E(S) AND ADDRESS (ES)		8. PEFORMING ORGANIZATION REPORT NUMBER 2000-03136-0
9. SPONSORING / MONITORING AGE National Aeronautics and Space Washington, DC 20546-0001		(ES)	10. SPONSORING / MONITORING AGENCY REPORT NUMBER TM—2000–209891 Vol. 71
11. SUPPLEMENTARY NOTES R. Zimmerman: Bayreuth Institu Bayreuth, Germany; K.C. McDo J. Nickerson: Raytheon ITSS	onald and J.B. Way: Jet Pro		
12a. DISTRIBUTION / AVAILABILITY STA Unclassified—Unlimited Subject Category: 43	TEMENT		12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Report available from the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.

The BOREAS RSS-17 team collected several data sets in support of its research in monitoring and analyzing environmental and phenological states using radar data. This data set consists of tree bole and soil temperature measurements from various BOREAS flux tower sites. Temperatures were measured with thermistors implanted in the hydroconductive tissue of the trunks of several trees at each site and at various depths in the soil. Data were stored on a data logger at intervals of either 1 or 2 hours. The majority of the data were acquired between early 1994 and early 1995. The primary product of this data set is the diurnal stem temperature measurements acquired for selected trees at five BOREAS tower sites. The data are provided in tabular ASCII format.

14. SUBJECT TERMS BOREAS, remote sensing science, tree bole measurements, soil temperature measurements.			15. NUMBER OF PAGES 27 16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL